PREPARING FOR RISING SEA LEVELS IN THE BAY AREA

APRIL 16, 2008

OAKLAND METROCENTER, AUDITORIUM

SCENARIO A

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

bcdc
Making San Francisco Bay Better

Association of Bay Area Governments

San Francisco Bay National Estuarine Research Reserve

PREPARING FOR SEA LEVEL RISE IN THE BAY AREA

A Local Government Forum

Wednesday, April 16, 2008 – 8:30 AM–4:00 PM
Oakland Metrocenter, Auditorium

Agenda

8:30–9:00 AM	Registration and Continental Breakfast
9:00–9:10 AM	Welcome, Overview of the Days Events, (Joe LaClair and Bruce Riordan)
9:10–9:45 AM	A Climate Change Strategy for the Bay Area (Will Travis, BCDC)
9:45–10:15 AM	Report on Climate Change Impact Assessment from the California Climate Action Team, Climate Scenarios Group (Dan Cayan, Scripps Institution of Oceanography and USGS)
10:15–10:30 AM	BREAK
10:30–11:30 AM	Local Government Efforts to Identify Vulnerabilities and Adapt to Projected Seal Level Rise: • Marin County – Alex Hinds, Community Development Agency Director – Policy initiatives in Marin County's General Plan and other County initiatives • SF PUC – Michael Carlin – Changes in our water supply, stormwater and wastewater system vulnerabilities and adaptation planning
11:30–12:00 PM	Discussion of Presentations and Sharing of other Examples
12:00–1:00 PM	Lunch
12:20–1:00PM	Keynote Address: Peter Gleick, Pacific Institute – Socioeconomic Impacts of Sea Level Rise in the Bay Area and Addressing Environmental Justice
1:00–2:30PM	Presentation of Vulnerability Template by BCDC Staff and Small Group Discussion
2:30–2:45 PM	Break
2:45–3:30 PM	Adaptation and Mitigation strategies: Jeremy Lowe, PWA, will describe how rising seas will affect Bay processes and adaptation planning and strategies for local governments to consider Ken Kirkey, ABAG: FOCUS Our Vision Program and the role of focused development Henry Hilken, BAAQMD: Air quality impacts, Adaptation and Mitigation strategies
3:30–3:50 PM	Question and Answer RE Adaptation and Mitigation strategies
3:50–4:00 PM	Wrap Up and Adjourn

Vulnerability Assessment Scenario A

The following describes a fictitious city on the shoreline of San Francisco Bay called Grateful Dell that is preparing to conduct an analysis of its vulnerabilities to impacts from sea level rise.

You are a member of the Grateful Dell climate preparedness team, made up of staff, experts and community leaders. Your climate preparedness team has identified planning areas that are likely to be vulnerable to impacts from sea level rise and is now conducting a thorough analysis to assess those potential vulnerabilities. In preparing your vulnerability assessment, you should assume a climate change scenario of a one-foot rise in sea level within thirty years, and a one-foot storm surge on that higher sea. Your group's task is to analyze several systems in different planning areas using the vulnerability assessment template.

Grateful Dell

Grateful Dell is a medium sized city of 115,000 inhabitants with a mix of incomes, but with a large low-income population. Its major industries are a maritime port, a regional shopping center, solar energy development and a variety of light industrial operations.

There are two shoreline neighborhoods. One is a middle-income neighborhood of modest single-family homes adjacent to a flood control channel that has narrow tidal marsh along its banks. The marsh provides habitat for two endangered species, the California Clapper Rail and the Salt Marsh Harvest Mouse. The flood control channel carries about 60 percent of the City's storm water flows, and is channeled by two earthen flood control levees, built by the US Army Corps of Engineers in the 1920's. On the other side of the flood control channel there is a federal public housing project managed by the Grateful Dell Housing Authority with 1,100 residents in newly-constructed two and three-story townhouse structures.

300-feet inland from the shoreline there is a 220-acre superfund site that was used for a large metal plating operation that closed in the early 1970's. The site is contaminated with heavy metals, solvents and hydrocarbons. The site elevation is mostly at or below existing mean high tide, and it lies just inland of the aforementioned neighborhoods and is protected by the flood control levees lining the flood control channel.

The City manages a sewage treatment plant located adjacent to the shoreline that is protected from the Bay by a levee with a crest 2.5 feet above mean high tide. The plant was built in the 1970's and constructed atop an historic tidal wetland that was diked from the Bay in the late 19th Century and the plant elevation is approximately 1-foot above mean high tide. The plant is not seismically retrofitted. The City provides water sanitation services to a portion of the neighboring city.

The City houses a mixed-cargo maritime port that accommodates container and break bulk cargoes, and construction materials, including gravel, sand and cement. The Port is a major employer in the community and has somewhat outdated equipment and the port's lands are between 3 and 7 feet above mean high tide.

Adjacent to the Port the State Parks Department owns and operates a 125-acre park that provides a fishing pier, 40 picnic sites, two large open lawn areas popular with soccer players, a tidal marsh, an interpretive center and a launch ramp used by those launching power boats and non-motorized small boats such as kayaks. The community has had a difficult time providing public open space and its own parks provide only 2.5 acres per 1000 residents. This park is heavily used by local residents, drawing over 65 percent of its visitors from Grateful Dell. Most of the facilities of the park are at or slightly above (up to 1 foot) mean high tide and are protected by levees with crests ranging from 2.5 to 3 feet above Mean High Tide.

Scenario facts:

Location	Fictitious San Francisco Bay Area city of Grateful Dell
Planning timeline	30 years from now
Sea level rise and storm surge scenario	1 foot of sea level rise and one foot of storm surge predicted
Evaluation method	Assessment Worksheet and vulnerability assessment template

Grateful Dell facts

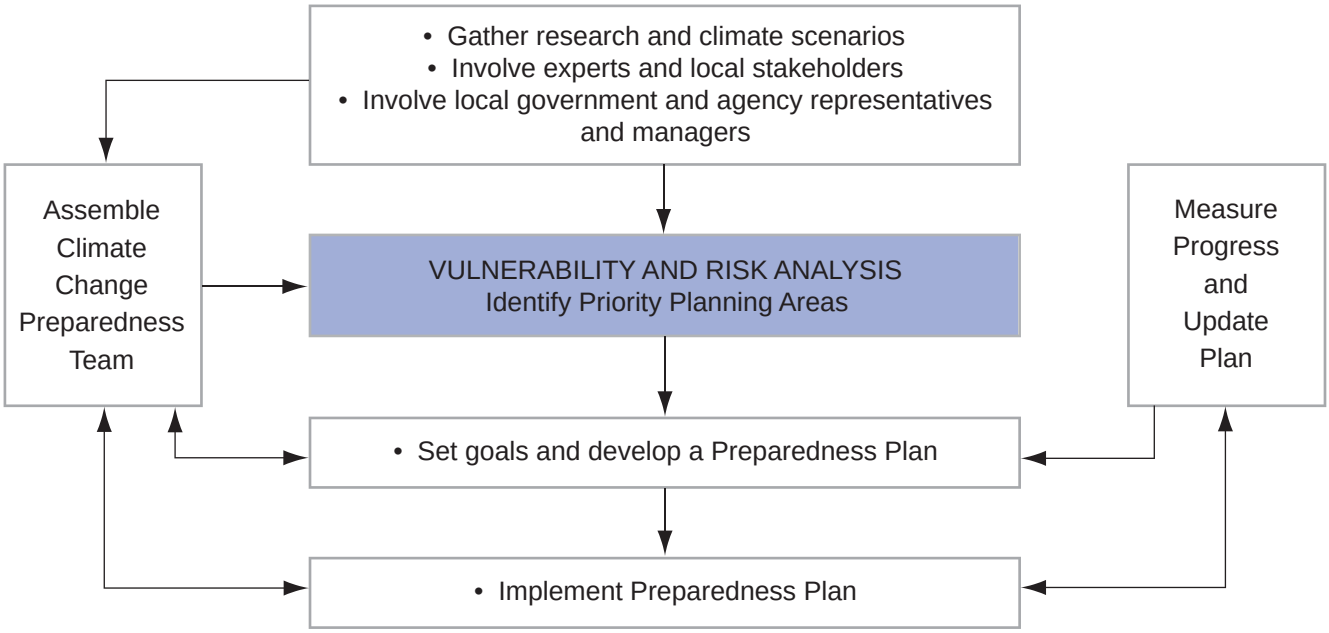
Location	Fictitious city in San Francisco Bay Area
Population	115,000
Major Industries	maritime port, regional shopping center, solar energy development, light industry
Endangered Species	California Clapper Rail and Salt Marsh Harvest Mouse in narrow tidal marsh along flood control levee
Housing Types	Single-family homes (middle-income) and townhouses (low-income); earthen flood control levee built in 1920's between neighborhoods; endangered species on banks of levee in narrow tidal marsh
Hazardous Waste Sites	Yes, one Superfund – heavy metals, solvents, hydrocarbons, site is at or below mean high tide
Treatment Plants	Sewage treatment plant built in 1970's atop historic wetland, not retrofitted, 1 foot above mean high tide; protected by levee with a crest 2.5 ft. above mean high tide.
Port facilities	Mixed-cargo, 3-7 feet above mean high tide
Parklands	125-acre park, at or slightly above (up to one foot) mean high tide
Flood Control	Flood Control channel adjacent neighborhoods; channel contains 60% of city storm flow; channelized by two earthen levees built in 1920's; narrow marsh on banks has endangered species

ASSESSMENT WORKSHEET

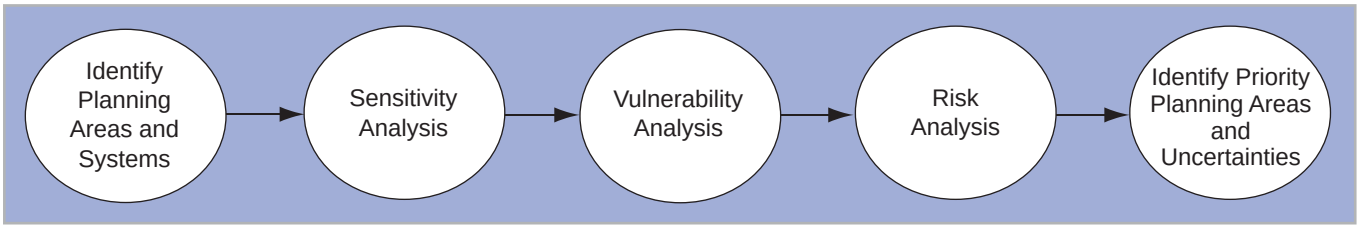
PREPARING FOR RISING SEA LEVEL IN THE BAY AREA

April 16, 2008

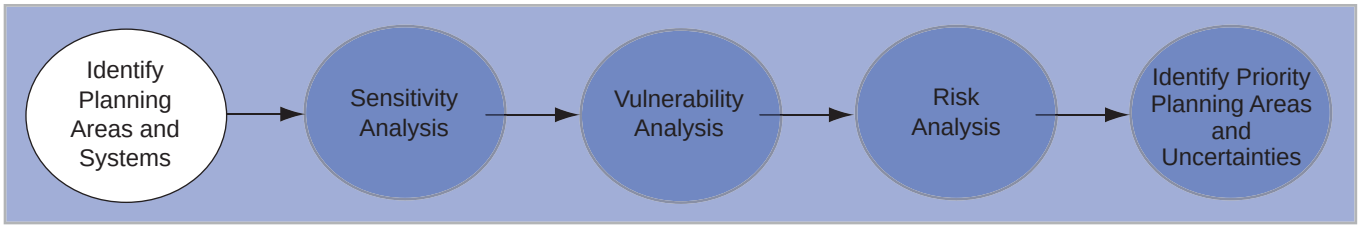
Developing and implementing a climate change preparedness plan includes six major steps:



This worksheet will guide you through the Vulnerability and Risk Analysis step towards developing a Climate Change preparedness plan. There are five tasks in this step that you must undertske to complete a vulnerability assessment, risk assessment, and identify priority planning areas for your fictional city.



Use the facts in the scenario provided to identify planning areas and systems and make judgments about climate sensitivity and vulnerability associated with those planning areas and systems. Where there are uncertainties about conditions, you must make assumptions about those conditions using your knowledge of climate change and Bay Area conditions. Instructions and questions for each section are provided to enable you to make judgments and progress through the assessment. Portions of each section have been completed as a guide to help you fill out the worksheet. In each Table there is a colored column. Answers in these columns will need to be transferred to subsequent tables in the assessment.



Task 1 – Identify your Location, Planning Areas and Systems

- The Location is the geographic area for which you are completing this assessment; this may be a city, region, or project.
- Planning Areas are the areas in which a government or community manages, plans, or makes policy affecting the services and activities associated with built, natural and human systems.
- Systems refer to the built, natural and human networks that provide important services or activities within a community or region.

Examples of **Planning Areas** and **. . . . . .** Systems

- **Water Supply:** Reservoirs; Water Treatment Plants
- **Natural Resources:** Wetlands; Endangered Species
- **Stormwater Management:** Sewage Treatment Plants; Flood Control Structures
- **Public Health Services:** Hospitals
- **Transportation Infrastructure:** Roadways
- **Housing:** Neighborhoods; Marinas/Houseboats
- **Ports:** Port Facilities
- **Outdoor Recreation:** Marinas
- **Air Quality Management:** Power Distribution Network
- **Waste Disposal:** Hazardous Waste Sites

Columns 1 and 2 – Planning areas and systems
What planning areas and systems are you using for your analysis? (Fill in Columns 1 and 2)
Why did you choose these areas for this analysis?

Column 3 – Current stresses to systems in each planning area
What are the current stresses (now, not in 30 years), irrespective of climate change, to the systems in each planning area? (Fill in Column 3)

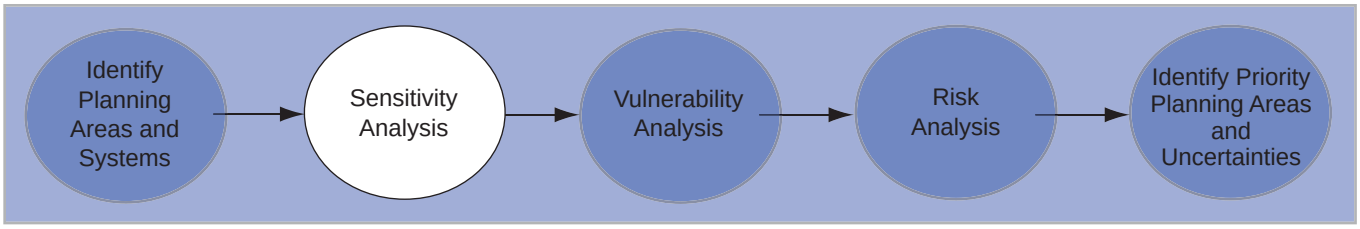
Examples of Stresses

- Water Quality
- Habitat Fragmentation
- Invasive Species Competition
- Eutrophication
- Aging Infrastructure
- Decreasing Population
- Development Pressures
- Decreased Freshwater Inflow
- Soil Contamination
- Undersized for Current Population

GROUP: _____

Location of Analysis _____

Table 1: Planning Areas and Systems		
Column 1	**Column 2**	**Column 3**
Planning Areas	***Systems***	***Current stresses to systems in each planning area***
I. Natural Resources	**A.** Wetlands	Water Quality (fill in additional stresses)
	B. Endangered Species	Decreasing population (fill in additional stresses)
II. Housing	**A.** (fill in system)	
III. (fill in planning area)	**B.** (fill in system)	



Task 2 – Sensitivity Assessment

Sensitivity evaluates how systems in a planning area are likely to be affected by projected changes in climate. If the system is likely to be affected, it should be considered sensitive to climate change.

- Copy the systems you identified in Column 2, Table 1 to the systems column (first column) in Table 2.
- Use the information from the fictional scenario to make assumptions about climate change impacts and how these changes will affect systems.

Column 4 – Current Climate Conditions Change
Describe how existing climate conditions in your location are projected to change? (Fill in Column 4)

Column 5 – Projected Impact to Systems From Climate Change

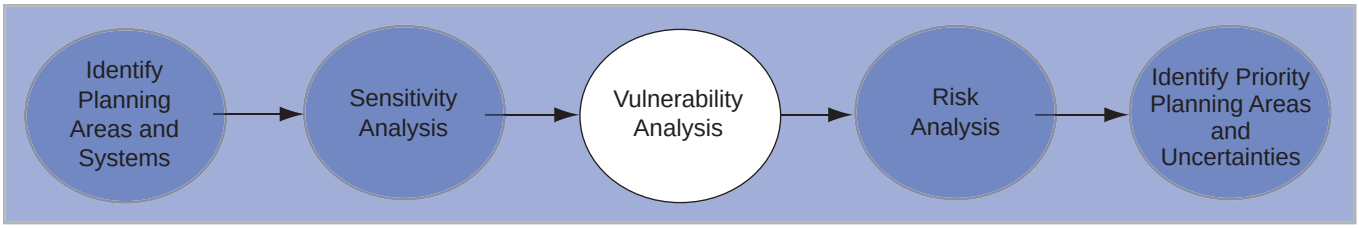
- Assess impacts to systems from climate change if no action is taken
- How exposed is the system to the impacts of climate change?
- Will climate change cause the demand for a resource to exceed its supply?
- Does the system have limiting factors that may be affected by climate change? e.g. for plant and animal species, is a species of concern in your system currently located near the edge or lowest elevation portion of its range?
- Will existing development be affected, or vital community services disrupted?
- What will happen if things continue as they are without preparing for climate change? Describe. (fill in Column 5)

Column 6 – Projected Change to System If No Action Is Taken
If no action is taken to prepare for climate change, will conditions in your systems improve, stay the same, or get worse? (circle answers in Column 6)

Column 7 - Degree of Sensitivity to Climate Change
Use the answers from Columns 4, 5 and 6 in Table 2 to determine the degree of sensitivity to climate change (circle answer in Column 7). If your system is likely to be affected by climate change, it should be considered sensitive.

Table 2: Sensitivity Analysis

Column 2	Column 4	Column 5	Column 6	Column 7
Systems (from Table 1)	***How are known climate conditions in your location projected to change***	***Describe projected impact (positive and negative) from climate change to systems if no action is taken***	***Projected change to system if no action is taken***	***Degree of sensitivity to climate change***
I A. Wetlands	1. Increase in sea level 2. Increase in storm surge	Increasing sea level may inundate wetlands (fill in additional impacts)	Improve Stay the same Get Worse	High Medium Low
I B. Endangered Species	3. Increase in storm intensity and frequency 4. Increasse in low water supply and drought	Increase in water and/or air temperature may negatively impact current populations in area (fill in additional impacts)	Improve Stay the same Get Worse	High Medium Low
II A. Housing	5. Increase in extreme heat events 6. Decrease in air quality		Improve Stay the same Get Worse	High Medium Low
III A.	7. Increase in energy demand		Improve Stay the same Get Worse	High Medium Low



Task 3 – Vulnerability Analysis

The vulnerability analysis evaluates the adaptive capacity of planning areas and systems.

- **Adaptive capacity** describes the ability of built, natural and human systems associated with a given planning area to accommodate changes in climate with the minimum disruption to current functions.
- The vulnerability analysis combines your findings on sensitivity with those on adaptability.
- Systems that are sensitive to climate and less able to adapt to changes are considered to be vulnerable to climate change impacts.

Copy the systems you identified in Column 2, Table 1 and the sensitivity rankings from Column 7, Table 2 to the first and second columns in Table 3.

Column 8 – Ability, or inability of the system to accommodate changes in climate

The following questions will help you assess adaptive capacity in your fictitious city:

- Are there barriers to a system's ability to accommodate changes in climate? Barriers may include legal, financial, or regulatory barriers, the amount of competing uses, the number of agencies that administer a system, and biological, geographic or physical barriers.
- Are the systems already stressed in ways that will limit their ability to accommodate changes in climate?
- Is the rate of projected climate change likely to be faster than the adaptability of the system?

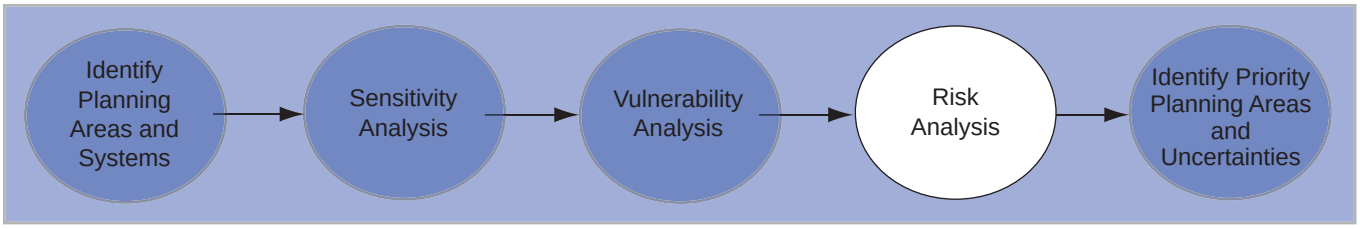
Describe the ability or inability of the system to accommodate changes in climate with minimum disruptions to current conditions (Column 8).

Column 9 – Adaptive Capacity
Using your answers to the questions for Column 8, rate the adaptive capacity of this system (rate in Column 9).

Column 10 - Vulnerability of the system
Using the answers for the Degree of Sensitivity (Column 7) and Adaptive Capacity (Column 9), determine the vulnerability of each system. If your system is sensitive to climate and has a lower adaptive capacity, it is vulnerable to climate change impacts.

Table 3: Vulnerability Analysis

Column 2	Column 7	Column 8	Column 9	Column 10
Systems (from Table 1)	***Degree of sensitivity to climate change (from Table 2)***	***Ability, or inability, of the system to accommodate changes in climate with minimum disruption to current functions***	***Adaptive capacity of this system***	***Vulnerability of system***
I A. Wetlands		Sea Level will inundate local wetlands. With additional sediment wetland could accrete enough to keep up with rising sea level. (fill in additional impacts)	High Medium Low	High Medium Low
I B. Endangered Species		No alternative habitat options	High Medium Low	High Medium Low
II A. Housing			High Medium Low	High Medium Low
III A.			High Medium Low	High Medium Low



Task 4 – Risk Analysis

The risk assessment, when combined with the vulnerability assessment, will allow you to determine your primary planning areas and systems.

- **Risk = (Consequence X Probability)**
- The **importance** of an impact should reflect the known or estimated (economic, ecological, social, cultural and legal) **consequence** of a particular climate change impact. The estimated scale of the impact, size of population and land area that is affected and also the cumulative costs of high frequency events, such as storms, should be factored in to your evaluation of importance and consequence.
- The **probability** is the likelihood of an impact occurring. Use information from the preceding analysis, climate change scenarios, and the following questions to estimate consequence and probability of impacts to your system.

Copy the systems you identified in Column 2, Table 1 to the systems column in Table 4.

Use the information provided in the fictitious city scenario and your knowledge of consequences and probability of climate change impacts in the San Francisco Bay Area.

Column 11 – Importance of climate change impact to system (Consequence)

- What are some potential consequences of climate change on the system?
- How important is the potential impact to your community?

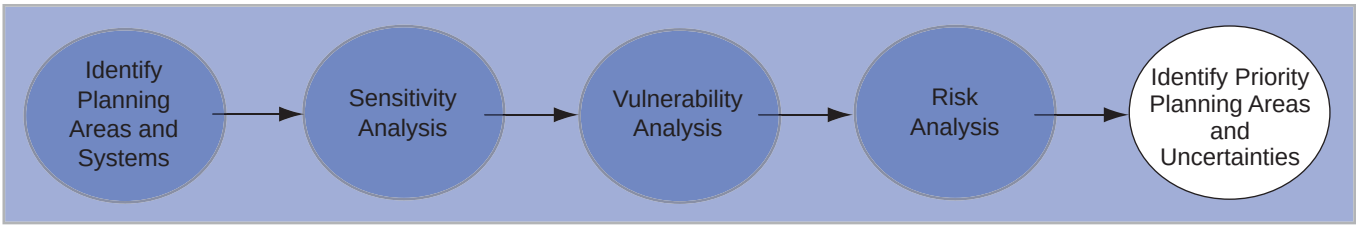
Circle your rating for Consequence of Impact in Column 11

Column 12 - Probability of climate change impact to system
Using the fictitious city scenarios, the preceding analysis, and your knowledge of climate change impacts in the Bay Area, rate the Probability of climate change impacts to each system.
(Circle in Column 12)

Column 13 - Estimated Risk to systems.
Risk may be estimated as the product of consequence and probability. Use the ratings for consequence and probability from Columns 11 and 12 to estimate risk (Circle your answer in Column 13).

Table 4: Risk Analysis

Column 2	Column 11	Column 12	Column 13
Systems (from Table 1)	***Importance of climate change impacts to the system (Consequence)***	***Probability of climate change impacts to the system***	***Estimated risk to system***
I A. Wetlands	High Medium Low	High Medium Low	High Medium Low
I B. Endangered Species	High Medium Low	High Medium Low	High Medium Low
II A. Housing	High Medium Low	High Medium Low	High Medium Low
III A.	High Medium Low	High Medium Low	High Medium Low



Task 5a – Determine Priority Planning Areas and Systems

After conducting your vulnerability and risk assessments, you can identify your **priority planning areas and systems.** These planning areas and systems are of particular importance to your community or region, are vulnerable to climate change and have a relatively higher risk of disruption from climate change.

Copy the systems you identified in Column 2, Table 1 the vulnerability rankings from Column 10, Table 3 and estimated risk from Column 13, Table 4 to the appropriate columns in Table 5.

Column 14 – Priority Rating
Use the Vulnerability-Risk Matrix below to analyze the rankings for vulnerability of the system (Column 10) on the x-axis, and estimated risk (Column 13) on the y-axis, and determine whether each of the systems should be a priority, may be a priority or is unlikely to be a priority.

Vulnerability-Risk Matrix

	Low Vulnerability	Medium Vulnerability	High Vulnerability
High Risk	May be a priority	Should be a priority	Should be a priority
Medium Risk	Unlikely to be a priority	May be a priority	Should be a priority
Low Risk	Unlikely to be a priority	Unlikely to be a priority	May be a priority

Task 5b – Evaluating Uncertainties

All risk evaluation processes have some element of uncertainty. This uncertainty may be from many different sources including understanding of particular issues, choice of climate scenario, timeframe used, quality of data, etc. It is important that these uncertainties be documented to assess the process and outcomes.

Column 15 – Uncertainty Level
What level of uncertainty do you think is associated with the Priority rating you assigned for this system in Column 14? (rate in Column 15)

Column 16 - Uncertainties
What are the uncertainties associated with the analysis of each system? Describe. (fill in Column 16)

- What methods could be used to reduce these uncertainties?
- What resources are needed to accomplish reduction of uncertainties?
- Which uncertainties are most critical?

Table 5: Priorities and Uncertainties

Column 2	Column 10	Column 13	Column 14	Column 15	Column 16
Systems (from Table 1)	***Vulnerability of system (from Table 3)***	***Estimated risk to system (from Table 4)***	***Priority rating***	***Uncertainty level***	***Uncertainties Describe***
I A. Wetlands			Should be a priority May be a priority Unlikely to be a priority	High Medium Low	
I B. Endangered Species			Should be a priority May be a priority Unlikely to be a priority	High Medium Low	
II A. Housing			Should be a priority May be a priority Unlikely to be a priority	High Medium Low	
III A.			Should be a priority May be a priority Unlikely to be a priority	High Medium Low	

Vulnerability Assessment Guidebooks and Tools

Preparing for Climate Change: A Guidebook for Local, Regional and State Governments. ICLEI; King County, Washington; Climate Impacts Group
http://cses.washington.edu/cig/fpt/guidebook.shtml

A "how-to" manual for taking adaptation all the way from theory to implementation in a format specifically designed for local and regional governments. This guidebook provides a lot of detailed information necessary for policy construction, a table of possible adaptive strategies, framework for assessing vulnerability and a section on implementation and lessons learned.

Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand. New Zealand Climate Change Office. http://www.mfe.govt.nz/publications/climate/coastal-hazards-may04/index.html

A detailed manual for coastal communities in New Zealand. The primary strength of this report is in the detailed chapters describing risk assessment and evaluation including a quantitative measure and model. There is also a detailed implementation section.

Community Vulnerability Assessment Tool (CVAT). NOAA Coastal Services Center.
http://www.csc.noaa.gov/products/nchaz/startup.html

Step-by-Step process for evaluating hazard impacts for communities and local governments. The website includes a case study and detailed information on the GIS analysis used in this method.

Cities Preparing for Climate Change: A Study of 6 Urban Regions. Clean Air Partnership.
http://adaptation.nrcan.gc.ca/index_e.php

Using the experiences of 6 cities in the U.S., Canada and the U.K., this report examines how climate change adaptation strategies and systematic assessment of impacts can be conducted. The report provides a good overview of adaptation options, barriers and lessons from early adopters.

Adapting to Climate Change: An Introduction for Canadian Municipalities. Canadian Climate Impacts and Adaptation Research. http://www.c-ciarn.ca/adapting_e.html

A relatively short introductory report that covers six case-studies of Canadian cities. The primary strength of this report is the suggested adaptive actions developed in the case studies.

Reports and Case Studies
A Survey of Climate Change Adaptation Planning. The H. John Heinz III Center for Science, Economics and the Environment.
http://www.us-ecosystems.org/Press_Releases/adaptation_survey.shtml

The most comprehensive report of climate change adaptation planning that has been compiled This report contains most of the detailed resources for adaptation and vulnerability analysis that focus on the U.S. and the Western world. This report surveys eight existing adaptation plans and 18 adaptation planning efforts in a variety of countries and ecosystems and an outstanding characteristic of each plan and planning effort is identified and analyzed.

Regional Impacts of Climate Change. Pew Center of Global Climate Change.
http://www.pewclimate.org/regional_impacts

This report presents four case studies of specific climate change impacts in different regions of the U.S. Although the studies in this report address specific regional impacts, cross-cutting themes emerge that are relevant to a wide array of regional and local climate change impacts.

Our Changing Climate: Assessing the Risks to California. California Climate Change Center.
http://www.climatechange.ca.gov/biennial_reports/2006report/index.html

Introduces IPCC climate scenarios and the potential impacts on California. Specifically addresses probably impacts to public health, water resources, agriculture, forests and landscapes, and rising sea levels. Although some climate change will happen based on current greenhouse gas levels, the most severe consequences for California that are expected from the medium and higher warming ranges could be avoided if heat trapping emissions could be reduced to lower warming ranges